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ABSTRACT

This paper presents a neo-Piagetian model for examining the development of early communication and language skills: discusses its origins in the current developmental literature, and provides a brief overview of a preliminary version of 12 scales developed for assessing communicative development based on the model. The model attempts to provide a comprehensive framework for examining the emergence of communicative competencies in the first 24 to 30 months of life in the context of Kurt Fischer's model of levels of cognitive organization. Through conceptual task analysis communication skills are broken down into several related but distinguishable aspects of interaction with persons that each develop through a common sequence of increasingly more complex, hierarchically arranged levels of organization. A longitudinal research study, currently underway, is designed to evaluate some predictions of the model and is being conducted in the context of an early intervention program for variously developmentally handicapped and at-risk children under 3 years of age. The ultimate objective is to use the model to guide the development of the communication assessment which will, in turn, provide a framework for the construction of a comprehensive social/communicative curriculum for early intervention. (Author/SS)

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A Model for Analyzing the Development of Early Communication Skills, According to Levels of Cognitive Organization

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A Model for Analyzing the Development of Early Communication Skills, Based on Levels of Cognitive Organization

Jeffrey M. Seibert, Ph.D.

Introduction

This paper presents a model for looking at the development of early communication and language skills that is being explored at the University of Miami's Mailman Center for Child Development. Following a description of the model, which includes a consideration of its origins in the current developmental literature, the paper will provide a brief overview of a preliminary version of a communication assessment being developed from the model. Preliminary data from a longitudinal research study currently underway that is designed to examine some predictions of the model will then be considered.

Development of the model represents an attempt to provide a comprehensive framework for examining the emergence of communicative competencies in the first twenty-four to thirty months of life in the context of levels of cognitive organization. Communication skills are broken down into several related but distinguishable aspects of interaction with persons that each develop through a common sequence of increasingly more complex, hierarchically arranged levels of organization. Our interest in such a model is not simply academic, since our research is being conducted in the context of an early intervention program for variously developmentally handicapped and at-risk children under three years of age. Our ultimate objective is to use the model to guide us in the development of the communication assessment which will, in turn, provide a framework for the construction of a

comprehensive social/communicative curriculum for early intervention.

The General Model and Its Assumptions

First, we will consider the basic assumptions of the general model and then translate them into specific implications for the development of early cognitive and communicative skills. The general model is based on a model for the development of cognitive skills that has been set forth most comprehensively by Kurt Fischer (1977) at the University of Denver. It is a neo-Piagetian approach that attempts to resolve what some interpreters of Piagetian theory believe represents a dilemma to the theory - the high incidence of decalages or differential rates in the emergence of skills that seemingly reflect the same underlying structural organization and so should appear simultaneously. The model asserts that specific experiences with materials to which the skills are to be applied and different information-processing demands of similar but not identical tasks are factors that affect the acquisition of skills just as critically as underlying cognitive structure.

According to Fischer, progress in the development of various cognitive skills can be characterized as passing through a fixed sequence of increasingly complex levels of organization; however, where a child performs in any particular task sequence will depend as much on his experience with the particular task set as it will on the presence of underlying cognitive structures. Therefore, asynchrony in development across different task domains is not only not unusual, but is predicted by the model. Level of organization, in other words, is used to characterize the task and not the child, since the level of organization that the child may display will depend on his experience in the task domain being tested.

As a point of clarification, it should be noted that Fischer uses the word cognition to describe the child's problem-solving with people as well as with objects. Therefore, considering communication and language development in the context of people-oriented problem solving processes should allow an analysis based on levels of cognitive organization similar to the analysis applied to the development of object-oriented problem-solving strategies. This formulation of cognition circumvents the cognition vs. language controversy that has dominated developmental psycholinguistics in the recent past. Object-oriented cognitive skills will be prerequisite to communication and language skills only when demonstrated to be critical to the performance of the communication skills. Therefore, the model calls for much more careful conceptual task analysis in the search for developmental prerequisites than has typically been in evidence in research evaluating the cognitive primacy hypothesis. This formulation, it should be noted, has much in common with Bates' and her colleagues (Bates et al, 1977b) "local homology" model for cognition and communication development.

A related corollary of the model is that ordinal sequences in the development of skills are likely to occur only 1) where one skill is a component of a second skill; 2) within narrow task domains where changes in the stimulus conditions are minimal while the response to the situation is developing through a series of levels of increasing complexity (e.g., the development from simple, indiscriminate repetitive actions with objects, such as banging and waving, to the socially appropriate use of the same objects); 3) where the same response must be given to increasingly complex

stimulus dimensions of a task (e.g., locating the hidden object on the various object permanence tasks).

Synchronous mastery is more likely to occur for two tasks that involve many related component skills than for tasks tapping less related skills; nevertheless, one related task may still be mastered earlier if the child has greater experience with all the skills that are components of success on that task. According to the model, then, most reported developmental sequences are more likely very typical sequences, given a minimal range of experience, rather than neccessarily ordinal.

The concept of underlying structure in the general model serves two functions: first, it provides a level of analysis for establishing a child's probable upper limit or optimal level of performance, at a particular point in time, in any task domain, given all necessary experience. The optimal level is established by determining the child's highest level of performance on any scale, as measured by the degree of structural complexity that underlies successful performance on the task. This notion of optimal level has interesting implications for intervention that will be considered later. Second, the concept of structure allows an analysis of a child's profile of competencies across different task domains that appear superficially unrelated but share a common underlying series of levels of organization. With the organizing concept of structure, a child's profile may reveal either synchronous, consolidated development or varying degrees of uneven, asynchronous development across task domains.

Application of the Model to Early Cognitive and Communicative Developments

The general model has provided the framework for a synthesis of the

relatively independent but converging theorizing and empirical evidence of several investigators, to generate a specific model for normal cognitive development between birth and about thirty months. Uzgiris, (1976, 1977) based on a detailed descriptive analysis of longitudinal observations of twelve infants during the first two years with the Uzgiris-Hunt scales, McCall, Eichorn and Hogarty (1977), through principal components analyses of the old Berkeley Growth Study data, and Fischer (1977), deriving his description from his theory of cognitive sets, have each suggested that there exist four successive levels of cognitive organization between birth and about thirty months that are each characterized by a qualitatively different mode of interaction with and control of the physical and social environments. McCall et al, (1977) in fact, describe a fifth level, an initial reflexive level, and this has been incorporated into the proposed model. Each new level represents an outgrowth or transformation of the previous level. The levels are very similar to Piaget's (1951, 1952, 1954) six stages of sensorimotor development but are described in terms of broader, common, underlying structural characteristics. We have adopted Uzgiris' (1976) terminology for the characterization of each of the levels (adding the reflex level to her original four), since it conveys the structural organization of each level most succinctly and satisfactorily. Table 1 presents each of these levels, along with their defining characteristics, which represent our compilation of the level characteristics suggested by each investigator. Specifically, the model asserts that, while a child may show, at the same testing date, a profile of behaviors or skills characteristic of several

Table 1

LEVELS OF DEVELOPMENTAL ORGANIZATION FROM BIRTH TO TWO YEARS
(based on Uzgiris, 1976, 1977; Fischer, 1977; McCall, Eichorn, & Hogarty, 1977)

LEVELS	DEFINING CHARACTERISTICS
LEVEL 0 Reflexes est. 0-2 mo	responsive rather than active responsive to selected stimulus dimensions that match structural dispositions of sensory-perceptual systems
LEVEL 1 Simple Unitary Action est. 2-7 mo	engages in undifferentiated & uncoordinated action indiscriminate application of schemes gradual modification of actions guided by perceptual contingencies acts on one object at a time & shows rhythmic alternation of actions
LEVEL 2 Differentiated Action est. 7-13 mo	perceives self as cause displays coordinated & joint activities and two-component actions differentiates schemes according to object/person characteristics can learn through physical prompting no immediate modification of action to feedback differentiates means from ends
LEVEL 3 Regulation by Differentiated Feedback est. 13-18 mo	coordinates social & object actions modifies component acts with feedback can associate 2 perceptually present forms can learn through observation distancing of schemes from context perceives cause-effect sequences as consisting of two related but independent events shows conventionalization of schemes & vocalizations
LEVEL 4 Anticipatory Regulation est. 18-24 mo	shows foresight and symbolic activity constructs and applies rudimentary relations between symbolic entities can learn through insight can adjust action prior to execution conventionalizations imposed by words evocation of absent objects & events

different levels, his acquisition of skills in any task domain can be characterized as passing through a sequence of levels of organization originating at the reflex level, passing through a level of simple, unitary, undifferentiated actions and interactions, to a level of differentiated but not easily modified actions, to a level of activity regulated immediately by feedback, and then to a level of activity modified by anticipation of outcomes and mediated by symbolic representation. This specific model is directing our efforts to develop a set of early communication scales. To facilitate an understanding of the model's application to the generation of a new set of scales, we will consider first how the model has been applied to an adapted version of an already existing set of ordinal scales, the Infant Psychological Development Scales (Uzgiris & Hunt, 1975).

Uzgiris (1976), as already noted, has used such a structural model to characterize the development of sensorimotor cognitive skills in her longitudinal sample. Interpolating from her analysis, we have constructed a profile to represent development through the five levels of object-oriented skills on five of the Uzgiris-Hunt scales, deleting most items from the original scales that entail obvious social interaction. Table 2 presents an overview of the profile.

The profile lists those items that we have interpreted, based on the defining characteristics of each level, to be criterial items or good exemplars of each level of organization for each cognitive scale. There are additional items for each scale not represented on this profile. An important caution should be noted at this point which applies equally to the assessment of communication skills. Although criterial items are

Table 2

SENSORIMOTOR PERFORMANCE PROFILE
(adapted from Uzgiris & Hunt, 1975; Uzgiris, 1976)

	Visual Pursuit and the Permanence of Objects	Means for Obtaining Desired Environmental Events	Operational Causality	Object Relations in Space	Schemes for Relating to Objects
0 Reflex	Focuses or fixates	Tries to remove cover from face			
1 Simple Actions	Finds a partially hidden object	Grasps a visually presented object	Directs general action at an object when the object's spectacle ceases	Grasps a visually presented object	Uses only simple schemes on all objects (e.g., banging, waving)
2 Different. Action	Finds a stationary object covered by a single screen	Uses a support already under an object to obtain the object when it is out of reach	Makes the object perform its activity manually	Follows the trajectory of an object that falls out of view	Uses complex differentiated actions on different objects
3 Regulation by Diff. Feedback	Finds an object visibly displaced under three screens and left under the last screen	Demonstrates understanding of the support relationship by pulling the support only when the object is resting on the support	Reactivates a hand-powered or mechanical object after demonstration by another	Understands the relationship of container and contained by turning container upside down to remove contents	Uses several objects in socially influenced ways
4 Anticipatory Regulations	Finds an object invisibly displaced to one of two locations alternately	Shows foresight in putting a long necklace into a container with an unstable base	Determines how to reactivate a mechanical object without a demonstration by another	Constructs detours around simple barriers to obtain objects that have just moved under or over the barrier	Shows early representational play (such as feeding a doll)

described in terms of particular behaviors, it should be recognized that the behaviors derive their significance as indices of object-oriented problem-solving strategies. Therefore, they should be generalized skills that the child evidences in more than one context with more than a restricted set of stimuli. Issues related to so-called "training" of cognitive skills will be considered later.

With this model-based profile for object-oriented assessment as a guide, we have attempted to construct an assessment for the development of social problem-solving (i.e., communication) skills, based on parallel levels of structural organization. The content of the communication assessment is not original with us but has been drawn from the wealth of data and insights in the literature that have resulted from the pioneering efforts of such investigators as Bates and her colleagues (Bates et al, 1975; Bates et al, 1977a; Bates, et al, 1977b); Benedict (1979); Bruner (Bruner, 1975a, 1975b; Ninio & Bruner, 1978; Scaife & Bruner, 1975); Dore (Dore, 1975; Dore, et al, 1976); Escalona (1973); Halliday (1975); Nelson (1973, 1974); Oller (1977); and Uzgiris and Hunt (Uzgiris & Hunt, 1975; Uzgiris, 1973, 1976, 1977). However, the breakdown of this content into the various related but distinguishable aspects of communication development that comprise the individual scales of the communication assessment represents our synthesis of the literature. Table 3 lists the twelve individual scales that we have developed for assessing communicative development across the five levels. Only the first six scales have been used in the data analysis to be reported later. Item gaps for some levels, failure to elicit representative behaviors, or reliability problems with the remaining six scales led to their exclusion prior to any data analysis. The final assessment instrument

Table 3

Scales of Early Communication Development

*1. Initiating Social Interaction

*2. Initiating Joint Reference

*3. Responding to Other's Efforts to Establish Joint Reference

*4. Use of Social Agents to Obtain Objects

*5. Use of Social Agents to Act on Objects

*6. Comprehension of Actio- and Event Reference

7. Metaphonological Development

8. Responding to Social Overtures

9. Maintaining Sustained Social Interaction

10. Development of Personal Reference for Entities and Events

11. Awareness of Others as Agents

12. Imitation of Gestures and Vocalizations

* included in the correlational analysis and the computation of mean communication level

should eventually include all twelve scales or some derivation of them.

Our next step in applying the model was to determine criterial items for each level for each scale. Table 4 presents the profile for the six scales used in the data analyses to be reported later. In order to develop the scales as probable ordinal sequences across the levels, according to the criteria provided earlier, it was necessary to break down most of the scales into two sub-scales before sequencing the communication skills representative of the particular scales. Similar to the object-oriented assessment and profile, the complete communication assessment instrument includes many items not included on the profile; only criterial items are listed on the profile. In assigning items to levels, the defining characteristics for each level of organization already presented in Table 1 directed our decisions. Decisions were supplemented but never overruled by suggested congruences in structural complexity for object-oriented and person-oriented skills as reported by Uzgiris (1973, 1976), McCall et al (1977), Bates et al (1977b) and Dunst (1978). There is necessarily some room for error and ambiguity in the application of these criteria to individual items. However, the analysis to be reported later should begin to evaluate the appropriateness of the level assignments. In addition, future conceptualizations of the levels of organization will attempt to draw upon the logical model of sensorimotor sets that Fischer (1977) has proposed to generate the various levels. Initial attempts to use Fischer's system to generate the scales were unsuccessful and so a decision was made to sequence the content according to the broader descriptive criteria.

The scales are still an uncomfortable mix of disjunctive and cumulative

Table 4

Communication Profile (Part I)

	Establishing Joint Reference or Attention to Objects		Comprehending Action/Event Reference	
	Initiates joint reference	Responds to other's attempts to establish joint reference	Actions with objects	Actions without objects
0				
1	Spontaneously looks to other while acting on object	Looks to object when other shows and comments	Turns to another's voice	
2	Alternates look between object spectacle and other	Follows other's point only if it makes contact with object	Inhibits object play to "No" or other sharp vocalization	Inhibits movement to "No" or other sharp vocalization
A 3	Shows object or points to it and looks to other	Follows other's line of regard (no point) to object to left or to right	Performs at least two very familiar actions with objects to gesturally prompted verbal directions	Performs at least two very familiar actions to gesturally prompted verbal directions
B	Spontaneously names object and looks at other	Selects (shows) object that other names from array	Performs at least two very familiar actions with objects to verbal directions (no gestures) in context, but not contrastively	Performs at least two very familiar actions to verbal directions (no gestures) in context, but not contrastively
4	Uses multiple word utterance to get other's attention to object	Finds object out of view when other labels	Performs at least three familiar actions with objects contrastively to verbal directions (out of context, no gesture)	Performs at least three simple familiar body movements to verbal directions contrastively (out of context, no gesture)

Table 4, cont'd.

Communication Profile (Part II)

	Initiating Social Interaction		Use of Social Agents to Obtain Objects	Use of Social Agents to Act on Objects	
	To gain proximity/ physical contact	To establish interaction		To reactivate mechanical objects	To reproduce object spectacles
0					
1	Reaches to nearby familiar non-interacting adult	Visually inspects other's face	Cries or fusses to object moved out grasp or reach	Shows only a motor or vocal procedure when object ceases	Shows only a motor or vocal procedure when adult ceases acting on object
2	Appeals for physical proximity with other	Appeals for the visual attention of other to self	Either looks to other or exhibits sustained reach to: a. object just moved out of reach. b. static object out of reach	Either looks to other or directs attention to other's hand when object ceases	Either looks to other or attends to other's hand when other ceases demonstration of spectacle
3 A	Appeals for physical proximity with other using a conventionalized gesture	Spontaneously gives object to other or initiates object give-and-take game	Gestural appeal and looks to other to: a. object just moved out of reach b. static object out of reach	Appeals by giving object to other or by using some conventionalized gesture with eye contact	Appeals by giving object to other or using a gesture with eye contact
3 B		Asks for potential routine social activity	Directs single word request to other for object out of reach	Directs single word request to other for repetition of activation	Directs single word request to other for repetition of demonstration
4	Calls for other who is out of the room	Uses multiple-word request for attention to self	Requests object out of view	Uses multiple-word request to other for repetition of activation	Uses multiple-word request to other for repetition of demonstration

item sequences, as defined by Wohlwill (1973), but it is hoped that future revisions and redefinitions will eliminate such inconsistencies. No item was assigned to more than a single scale in order to avoid artificially inflating correspondences across scales. Level 3, it should be noted, has been broken down into two sub-levels for the communication scales, the earlier level encompassing skills that reflect directed communication and conventionalized gestures, the latter incorporating conventionalized, referential, but non-symbolic vocalizations or signs which, although perhaps more complex, are nevertheless considered to be indicative of the same general level of cognitive organization as the non-verbal conventionalized appeals.

The Research Study

With this brief introduction to the model and the profiles for the cognitive and communicative assessments derived from it, we turn to a consideration of a longitudinal research project in progress that is designed to evaluate some of the predictions of the model.

Both assessment instruments are being administered to a group of young handicapped and at risk children who have been enrolled in a daily center-based program of early intervention at the Mailman Center for Child Development. In all, 58 children have been assessed on both sets of scales concurrently, but the data for eleven children were eliminated prior to any of the analyses either because of incomplete data or because the nature and severity of their handicap prevented them from responding in a way that was readily interpretable. The sample includes 47 children between 9 and 42 months chronologically with a mean age of 27.8 months and a standard deviation of 8.4 months (corrected age for those who were

premature). Based on Bayley's or Cattell's administered within about one month of the other assessments, the quotient range is from considerably less than 50 to 112. The mental age range of the sample is from 4 months to 35 months with a mean of 16.4 months, standard deviation 7.4 months. Physical age range is from 4 months to 28 months with a mean of 16.5 months, and a standard deviation of 7.7 months. The nature of handicaps in the final sample includes high risk (premature), mildly visually impaired, CP, hydrocephalic, hearing impaired, Down's Syndrome, emotionally disturbed and autistic or autistic-like. Excluded from the sample were deaf-blind youngsters and those with physical disabilities so severe that they are unable to demonstrate reach and grasp. While some may question the logic of an investigation on such a heterogeneous sample of children, it is our belief that any consistent patterns and relationships that emerge from research with such a sample will indeed be robust. Not all 47 subjects were included in all of the analyses and when the sample is reduced for any analysis, criteria for exclusion will be noted.

Data from one testing period exist on all 47 children; in addition, eighteen of the children have been assessed twice, at roughly four month intervals, providing a small body of longitudinal data that can supplement the interpretation of the cross-sectional data. For these eighteen subjects, only their most recent data are included in the cross-sectional analyses. Thirty-eight of the 47 children were evaluated within a week on both the cognitive and communication instruments, 8 were evaluated within 2 weeks, for one there was a 2½ week delay, and for one a 5 week delay.

To avoid any bias or "cross-contamination" of the data between cognitive

and communication assessment and scoring, all cognitive assessing, scoring and reliability determination was carried out by two research assistants who had no involvement in the communication assessment and no access to the results. All communication assessing, scoring and reliability determination was carried out by two other research assistants and the investigator, prior to any knowledge about the results of the cognitive assessments. Furthermore, the communication assessment was conducted and scored using a protocol and score sheet that made no reference to levels or scales. All testing sessions were videotaped and scored independently by two raters. Procedures for the cognitive assessment can be found in Uzgiris and Hunt (1975), although additional standardization of procedures and scoring criteria were introduced into the present testing. Communication assessment involved a loosely structured but carefully determined set of responsive interactions between adult and child designed to elicit or encourage all the communicative behaviors of interest. A research draft of the instrument currently exists which will be revised for eventual dissemination. Considerable warm-up time between the tester and the child was allowed, up to four or five sessions across different days, to assure warm and comfortable interactions between the child and the tester. The mother or the teacher would have been a preferred interactive partner with such young children, but practical constraints made such an arrangement impossible for the present data collection.

Level scores for each scale for both cognition and communication scores were assigned based on the highest criterial item the child passed in each scale. For the communication scales comprised of two sub-scales, the

highest criterial item passed in either of the sub-scales was used to determine level score for the overall scale. In addition, an average level and a median level score for both communication development and cognitive development were computed for each child. The mean was computed simply by summing the level scores for each of the scales in each domain and dividing by the number of scales. The six communication scales noted earlier in Table 3 were used in this analysis.

It should be noted that the computation of level means can be questioned on psychometric grounds since neither set of scales has been demonstrated to be an interval scale and only the cognitive scales have evidence to establish their ordinality. However, setting aside the ordinality issue for the communication scales, which can probably be defended on logical grounds but awaits more complete longitudinal data, a case could be made that both sets of scales, using only single criterial items for each level, may in fact approximate interval scales. The normal developmental month differences for items at successive levels, where such information exists, approximate a one-to-one ratio. Median scores, acceptable psychometrically, lose some detail that the mean level scores provide; therefore, the analyses to be reported later will use both sets of dependent measures in order to provide as much detail as possible while maintaining a psychometrically meaningful reference point.

Results

Reliability has been determined on about two thirds of all scores used in any of the analyses to be reported. Inter-rater reliability for level assignments for each scale ranges from 85% to 100%. Reliability for

the individual items reported on is all above 90%.

There are two major issues derived directly from the model that an analysis of the assessment data can be addressed to. The first is concerned with how successfully our communication assessment profile has been constructed to reflect the basic structural levels of cognitive organization described earlier and to parallel those for object-oriented problem-solving skills and, perhaps even more basically, whether there is any reason to believe that this is a reasonable enterprise and that the levels have a basis in reality. It is unlikely that we shall ever conclusively prove the existence of such underlying structural levels of organization that cut across skill domains and it is not even apparent what would constitute proof. However, there are some ways of looking at patterns across individual children's communication and cognitive performance on the scales to determine whether the model is at least viable and makes sense and whether it should have any practical implications.

The second major issue that can begin to be addressed with the assessment data is whether observed patterns in the acquisition of various skills targeted by the assessments are consistent with assertions the model makes about prerequisites. The model predicts that there should be many alternative pathways of skill mastery and many different profiles of development resulting from different individual experiences. Only where a strong case can be made that one skill or concept is a necessary component to the achievement of a second skill should a fixed order of acquisition be observed.

Turning first to the issue of common levels of structural organization for object-oriented and people-oriented problem-solving, let us consider

several approaches to the data. A very obvious initial approach would be to compare means and standard deviations for each of the scales in each assessment domain. While an individual child may have scores on the different scales at different levels, it seems reasonable to expect that in a large enough sample, the averages across the scales would tend to approximate each other, if the scales are sampling skills of similar structural difficulty. Table 5 presents the means and the standard deviations for each of the scales from both assessment instruments, as well as the composite means. What is an acceptable range is a matter of judgment, but the figures are certainly not inconsistent with the structural level approach. The overall means in fact are quite similar, the range being only half a level between extreme scores. Object permanence, the most extreme high score, poses an interesting challenge. Is it higher because it tends to lead developments in the other domains, as Uzgiris and others have suggested, or is it higher because of an error resulting from ambiguous criteria in determining which items in fact index higher level skills? In particular there is a controversy currently over which object permanence tasks in fact require true symbolic or representational skills (e.g., Bertenthal, 1978; Miller, Chapman, Branston, and Riechle, 1978).

A second approach to the issue of common levels of organization would be to examine the correlations between cognitive and communicative mean and median level scores; the model predicts that the correlation between the two sets of scores should be fairly substantial. However, in attempting this analysis, several concerns that affect the interpretation of the

Table 5

Means and Standard Deviations by Level Score for Each Communication and Cognition Scale (N=47)

Scale	Mean	Standard Deviation
Action Comprehension	2.69	1.03
Initiating Social Interaction	2.57	0.79
Use of Agents to Obtain Objects	2.57	1.02
Use of Agents to Act on Objects	2.79	0.57
Initiating Joint Reference	2.53	0.95
Responding to Joint Reference	2.88	0.92
Composite Communication	2.67	0.75
Object Permanence	3.00	1.44
Means/Ends	2.60	0.89
Operational Causality	2.51	1.13
Object Relations in Space	2.87	1.21
Schemes	2.62	1.04
Composite Cognitive	2.72	1.01

results must be addressed. High correlations, even if observed in this heterogeneous sample, could nevertheless be confounded by a strong relationship with chronological age. Since there are fifteen high risk children in the sample of 47 who are all functioning in the non-retarded range and have no detectable impairments that might contribute to atypical development, the decision was made to eliminate their data from the analysis in order to reduce the correlation of cognitive and communicative developments with chronological age. The correlation analyses to be reported therefore are based on data from 32 children, ranging in age from 9 months to 42 months with a mean of 28.3 months and a standard deviation of 9.1 months, and ranging in mental age from 4 months to 27 months, with a mean of 13.4 months and a standard deviation of 6.0 months.

A second concern is that, although development may not be correlated with chronological age in this reduced sample, high correlations between communication and cognition level could nevertheless reflect the effect of some broader underlying developmental/maturational function that is more encompassing than the structural levels of cognitive organization. There is no apparent reason to predict, based on the model, that physical/motor development should be strongly related either to communication or cognitive development. The cognitive scales include a few items that rely on sophisticated motor skills (e.g., activating mechanical toys and making detours) and so a modest relationship may exist between these two domains. However, the communication scales, for the most part, require minimal motor abilities. Therefore, a pattern of high correlations across

all three domains (communication, cognition, motor) would cast doubt on the validity of more specific levels of underlying cognitive organization that relate only communication and cognition. The existence of Bayley mental and physical age estimates for all 32 children, determined within a month of their cognition and communication assessments, makes an analysis of the relationship across these three domains possible. The mental age estimates allow for an independent measure of cognitive functioning that could provide a degree of construct validation to the object-oriented cognitive measure.

A series of pair-wise correlations was performed to determine the strength of the relationships among chronological age, Bayley mental age, Bayley physical age, mean level for communication, mean level for cognition, median level for communication, and median level for cognition. Means and standard deviations for the reduced sample by individual scales are reported in Table 6. The pattern is similar to that observed for the entire sample, with lower overall means. The results of the series of correlational analyses are reported in Table 7. Significance of correlation at the .001, .01 and .05 levels is noted. The patterns are strikingly consistent with the predictions of the model, regardless of whether mean or median levels scores for cognition and communication are used. The pattern of correlations is all the more impressive when one is reminded of the heterogeneous nature of the sample that the data for the analyses are derived from.

Most correlations are significant, even at the .001 level, but what is more interesting is the pattern of magnitudes of the correlations. Chronological age, as anticipated with this sample, is

Table 6

Means and Standard Deviations by Level Score for Each Communication and Cognition Scale for Reduced Sample (Excluding High-Risk, N=32)

Scale	Mean	Standard Deviation
Action Comprehension	2.31	1.04
Initiating Social Interaction	2.44	0.83
Use of Agents to Obtain Objects	2.25	0.97
Use of Agents to Act on Objects	2.64	0.62
Initiating Joint Reference	2.30	1.01
Responding to Joint Reference	2.56	0.93
Composite Communication	2.42	0.77
Object Permanence	2.62	1.58
Means/Ends	2.37	0.93
Operational Causality	2.25	1.17
Object Relations in Space	2.59	1.25
Schemes	2.37	1.05
Composite Cognitive	2.44	1.06

Table 7

Correlations among Chronological Age, Mental Age, Physical Age, and Mean and Median Levels for Communication and Cognition (N=32)

	CA	MA	PA	Mean Comm.	Median Comm.	Mean SM	Median SM
CA							
MA	.58***						
PA	.67***	.78***					
Mean Comm.	.33 ns	.78***	.38*				
Median Comm.	.29 ns	.74***	.33 ns	.97***			
Mean SM	.52 **	.92***	.67***	.88***	.86***		
Median SM	.60 ***	.92***	.71***	.81***	.79***	.97***	

* $p < .05$
** $p < .01$
*** $p < .001$

only modestly correlated with most of the other variables and not significantly correlated with communication level. Mental age, on the other hand, correlates more highly with the communication and cognition measures but, in particular, with the cognition measures, which provides independent support for the validity of the object-oriented assessment as a measure of cognitive functioning. Interestingly, physical age correlates fairly substantially with mental age, and this relationship is reflected in the fairly strong relationship between sensorimotor scores and physical age. However, what is more important to the predictions of the model is the low or non-significant correlation of physical age with communication level, coupled with the very strong relationship between cognitive scores and communication scores. If the relationships among domains were simply a function of a more general developmental/maturational factor, then communication would be expected to relate just as strongly to physical age as to object-oriented cognitive level. The fact that communication relates strongly to cognitive level but not to physical age provides strong support for the model's assertion that object-oriented cognition and communication are related in a structural way that is independent of a more general developmental function.

The finding that object-oriented cognition relates to physical age in no way invalidates this claim. That a relationship might exist between these two domains was already anticipated since successful performance on some cognitive items requires a fairly advanced degree of motor ability. High correlations between medians and means and similar patterns of correlations with both kinds of measure suggest that both measures of central tendency provide similar information.

A third approach to the issue of common underlying structural organization between the cognitive and communicative domains is a descriptive one. Having established the existence of a strong relationship between cognition and communication as measured by the model-generated instruments, there remain additional questions about the nature of this relationship that can begin to be answered by looking at individual patterns of scores. Do developments in one domain tend to lead developments in the other or, as the model predicts, is the relationship more non-specific, with some children showing more advanced communication skills while others display more advanced cognitive skills? To answer this question, we proposed to look at each individual's mean communication level score relative to his mean cognitive level score. Perfect level correspondence between the two domains for all children is clearly not a prediction of the model, because differential experiences will affect development of skills in each domain differentially. The model predicts that the difference scores between mean levels in communication and cognition should approach a symmetric distribution around the zero point, with an obvious mode around zero, if in fact the levels in each domain are structurally equivalent and neither domain neccesarily leads development in the other domain. The results of the test of this prediction are presented in Figure 1, for the differences in mean levels, with mean cognitive level as the anchor point. The distribution of differences is as predicted. Frequencies to the right of the zero point represent those children with mean communication levels higher than cognitive levels; to the left of zero are those with mean communication scores lower than their

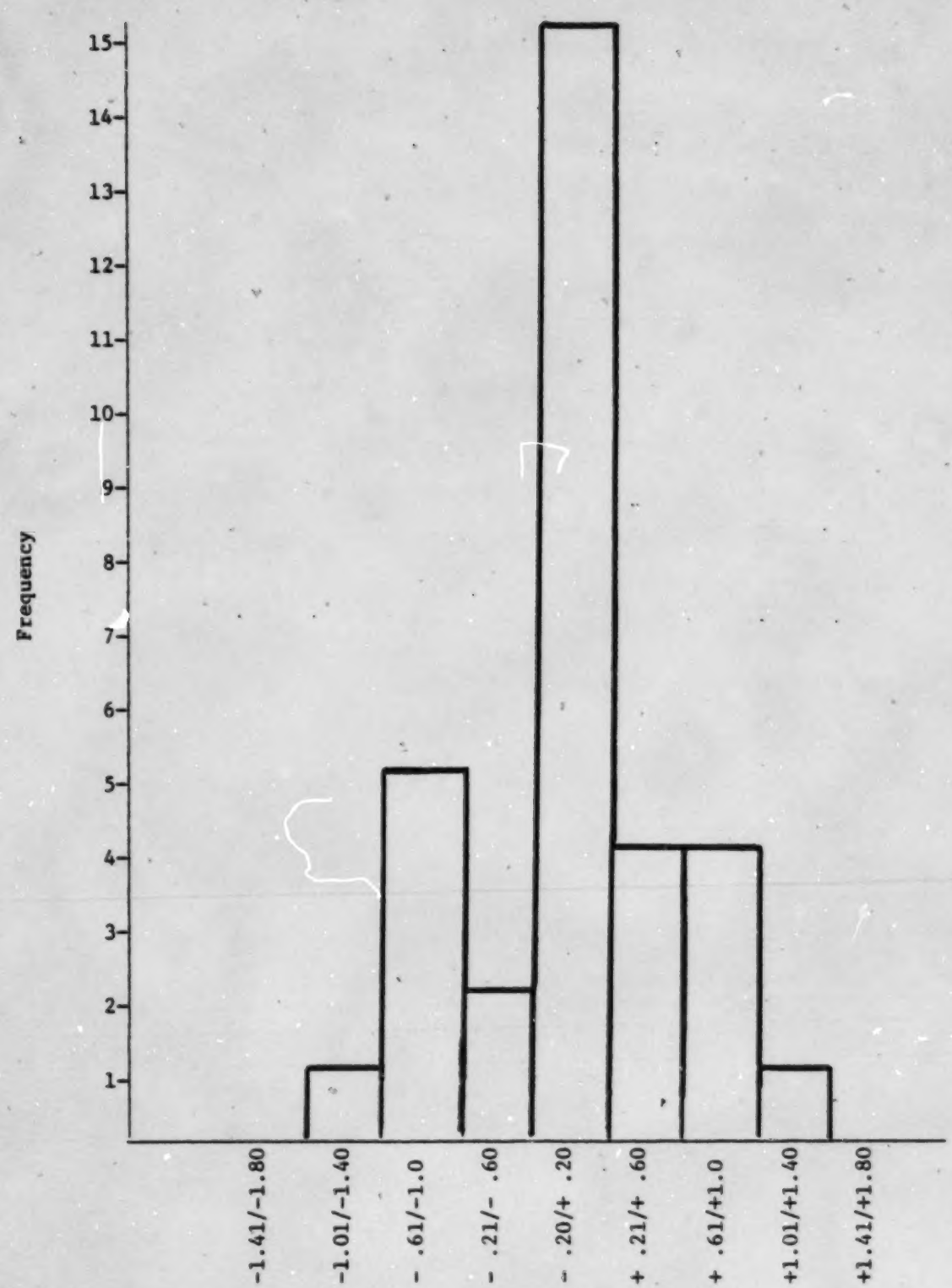
cognitive scores. The dominant cluster of differences around zero and the roughly equal distribution of scores on both sides of the zero point (8 vs. 9) argue very strongly for the structural equivalence of the levels in the two domains. Were there differential difficulty in the items assigned to the same levels in the two assessment areas, it should have produced a shift in the peak away from the zero point, to the right if the communication items in general were easier, and to the left if they in general were harder. An inspection of the mean level discrepancy scores in both directions indicates that discrepancies are distributed evenly across all levels. There is no evidence that the results are simply an artifact of ceiling or floor effects. Correspondence in levels is no more likely to be observed at either the highest or the lowest levels.

Further support for the psychological reality of the levels and their application across domains awaits training studies designed to test other predictions about levels and shared organizational structure derived from the general model. The evidence strongly supports the model and suggests the heuristic value of further exploration of both the model and the assessment instrument.

The second major issue, the prediction of patterns of acquisition of skills, will be touched on only briefly with a single illustrative example from the data. Recall that the model predicts fixed sequences of acquisition of skills only where a strong case can be made that one skill is a component of a second skill.

The example we will focus on bears on the emergence of conventional words or labels for objects. Issues related to this development have

Figure 1: Frequencies of Discrepancies Between Mean Communication and Cognitive Levels in .4 Stage Intervals (N=32)



Differences in Overall Mean Communication Level Relative to Overall Mean Cognitive Level in .4 Stage Intervals

received considerable attention in our research since we consider the understanding of labels for objects to be a pivotal development involving the intersection of object-oriented cognitive and social-communicative skills. Other details of our findings will be discussed in a future report, (Seibert & Hogan, in preparation) but for the purposes of this paper, we will consider one essential aspect, the acquisition of receptive labels. Guided by the model, we proposed the following conceptual task analysis for the development of receptive labels for objects. We hypothesized that for a child to demonstrate that he understands labels for objects (which we operationalized as the child's ability to locate and choose objects named by another from an array), he must first acquire several component skills. He must have the capacity to form concepts for classes of objects so that an individual object can be recognized as an instance of the particular class. Behavior that demonstrates this conceptual ability, we proposed, and others (e.g., Bates et al, 1979; Nelson, 1974) seem to concur, is the performance of socially influenced actions on various instances of classes of objects (or perhaps more accurately, placing objects in particular spatial relations with parts of one's own body), such as putting a comb to the hair, placing beads around the neck, or holding a telephone up to the ear.

These socially influenced actions go beyond the level of acting on the object simply as a function of its physical characteristics to a beginning conceptualization of the class of objects according to social function. It should be noted that our criteria for crediting a child with this level of actions on objects are stricter than mere appropriate use of objects (e.g., eating from a spoon or drinking from a cup are not scored

as instances of socially influenced actions but are scored simply as functional actions). It is the recognition of the object in its social role (that may serve no obvious function for the child besides a social one) that we consider as evidence of this important conceptual ability.

A second component skill that we proposed as prerequisite to the development of receptive labels is the ability to perceive another as a referrer, that is, as one who exists in an objective spatial framework that includes himself, the child and objects, and who can direct his own attention (as well as the child's) to the objects in his visual field. Our rationale for considering this skill as a component skill to receptive labels is that reference is a social function (as Bruner, 1975a, 1975b, has eloquently argued). Before a child can understand that another's vocalization is a label for an object, he must first understand the other person as someone who can refer to objects, perhaps by looking at or pointing to objects and then later, by vocalizing about objects.

We proposed that evidence that the child appreciates the other as one who can refer can be found in the child's ability to follow another's line of visual regard to a distant object (without a point, although at the level of mastery of this skill, a point seems to hinder more than help). The child's ability to locate an object simply by following another's gaze strongly suggests that the child perceives the other as looking at the object and therefore as capable of assuming the role of referrer.

An experience in addition to these two component skills that would appear to be prerequisite to the development of receptive labels would be the experience of hearing and associating the word sound (or signing gesture) with the object or with other instances of the same class of objects.

Whether such an association can be established without the presence of the two component skills hypothesized to be prerequisite to receptive labels is an empirical question; the issues involved will take us too far afield from the purposes of this paper and so will be addressed in a future report.

A point of clarification about the relationship between prerequisite component skills or concepts and indexing behaviors is probably necessary before considering our findings. Working with the heterogeneous population that we do, we would be the first to acknowledge that the behaviors themselves cannot necessarily be prerequisites. For example, many blind children who cannot follow another's gaze learn receptive labels; many children with cerebral palsy who cannot perform socially influenced actions also develop vocabulary. The conceptual task analysis of the model asserts that the skills or concepts underlying these behaviors, which should be displayed if the concepts are there and the child has the behavioral capacity to perform the actions, are the prerequisites to acquiring receptive labels. Therefore, in all but the most unusual situations, children should first follow another's line of regard and display socially influenced actions on familiar objects prior to acquiring receptive labels. The model predicts no particular order of acquisition for socially influenced actions and following line of regard, since neither is a component of the other in any obvious way. Order of acquisition should depend on the relative nature and amount of experiences each child has with the different situations that foster acquisition of the two skills. Since all three of these skills are assessed with our instruments, we should be able to evaluate this hypothesis. The cross-sectional data presented in Table 7, while not conclusive, are quite persuasive: 17 children (not shown) display

Table 7

Individual Profiles for Socially Influenced Schemes, the Ability to Follow Another's Line of Regard, and Receptive Labels for Objects (N=34)
(to evaluate the hypothesis that the schemes and line of regard skills tap component skills for receptive labels, but are not themselves ordered developmentally)

Socially Influenced Schemes	Follows Line of Regard	Receptive Labels
+	−	−
+	−	−
+	−	−
−	+	−
−	+	−
−	+	−
−	+	−
+	+	−
+	+	−
+	+	−
+	+	−
+	+	−
+	+	−
+	+	−
+	+	+
+	+	+
+	+	+

Socially Influenced Schemes	Follows Line of Regard	Receptive Labels
+	+	+
+	+	+
+	+	+

none of the three skills; 3 children evidence only socially influenced schemes; 4 children evidence only the ability to follow another's line of regard; 7 children have both socially influenced schemes and the ability to follow line of regard but no receptive labels (recall that the additional experience of associating the name-sound with the object is necessary) and 15 children have all three skills. Only a single child fails to conform to the predicted pattern; this child has two receptive labels and socially influenced actions on objects, but has consistently followed only a single line of regard trial in each testing session, therefore failing to reach criteria for a pass. Interestingly, this child has also been described as autistic, engaging in a high frequency of stereotypic activities and generally avoiding eye contact with others.

The longitudinal change data on the eighteen children supplement the conclusions from the cross-sectional data. While only two of the eighteen children showed mastery of receptive labels between spring and summer, in both cases, socially influenced actions were present in the spring, ability to follow line of regard was absent, and the children mastered this skill during the spring to summer time span. The evidence therefore, strongly supports the hypothesized prerequisite nature of the concepts underlying these two skills for the acquisition of receptive labels. The sequence of acquisition for the component skills themselves, socially influenced schemes and following line of regard, does not appear to be ordered, matching our prediction. Training studies will be required to validate the sequence but the model has proven fruitful in suggesting a line of inquiry that will have obvious intervention implications. The

purpose of this example has been to make clear the assertion of the model that one should look for ordinal sequences only where one has strong reason to believe that one set of skills provides the literal building blocks for the later skill or skills.

Conclusions

The model presented in this paper is not intended to be the only way to look at the development of communication skills. It is only one alternative that should be evaluated in terms of its usefulness in unraveling the processes of communicative development and providing the practitioner with a framework for making better decisions about how to intervene with the young child with developmental problems. The results so far encourage cautious optimism that the assessment profile derived from the model will be a useful tool. Further conceptualization and research lies ahead in order to validate the model, operationalize the levels, determine whether individual scales are in fact ordinal and detail inter-relationships across scales and domains.

The value of conceptualizing the scales in terms of successive levels of organization lies, in part, in the information it can provide on where to intervene with the delayed child. A total cognitive and communicative profile presents a composite picture of a child's relative strengths and weaknesses that can guide the interventionist in his search for strengths to build upon. Some further predictions of the model remain to be tested in future training studies that will attempt to determine how successfully one can predict differential success in training the same skills to youngsters who are at the same skill level in the target area

but who evidence different optimal levels within or across domains. We already have some evidence that we can predict who will benefit more from training on a series of self-recognition tasks (from Bertenthal & Fischer, 1978) as a function of their object permanence and means-ends level scores, relative to their self-recognition level scores (Seibert, deCubas & Calejo, in preparation). It may also be that training strategies will differ significantly depending on whether one is attempting to teach a skill that is near the child's optimal level or to teach a skill from a scale where the child is showing a lag relative to other scales. The implications of the model are that to master a lagging skill, the child already has the structural organization and simply needs the content experience. On the other hand, to master a skill near the child's optimal level may require experiences that produce a qualitative shift in how the child looks at and interacts with the world. The distinction is a process vs. content distinction. Knowledge about how to intervene to facilitate both kinds of skills is essential for the effective practitioner. Ultimately, the proof of the model will lie in its success or failure in application.

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